SECOND

INTERIM REPORT

ON STUDY OF

ARTERIOSCLEROTIC HEART DISEASE

AMONG

NAVY AND MARINE CORPS MEMBERS

NAVY DEPARTMENT
PHYSICAL QUALIFICATIONS AND MEDICAL RECORDS DIVISION
BUREAU OF MEDICINE AND SURGERY
APRIL 1966

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Appendix A: Lettered Statistical Tables (Bound Separately).

In addition to the numbered tables included in the body of this report, there are other, additional, lettered tables in Appendix A, of lesser importance or furnishing additional background material.

Appendix B: Regional Differences in Birthplace Distribution (Bound Separately).

Appendix C: Comparison of Control Sample with ASHD Patients (Bound Separately).

NUMBERED LIST OF STATISTICAL TABLES IN TEXT
(Lettered Tables are Bound Separately in Appendix A)

SPECIAL PRECAUTIONARY NOTE

If these finding were to be widely published--in a series of journal articles or in a public report--a few parts of them would have to be deleted. This would be necessary because the criteria for inclusion in such a public report generally require adherence to a definite and specific standard of statistical significance--usually a 5 percent level of significance (i.e.--a probability that the results would be incorrect in no more than 1 out of 20 trials with this size sample).

However, since this is an exploratory or pilot study, we are not only interested in findings which are significant to the foregoing 5 percent level but are also interested in relationships allowing a somewhat larger chance of being incorrect. That is, we wish to examine ASHD-related factors which not only are "probably" significant but also those factors which are "possibly" significant. We have, therefore, accepted criteria for inclusion, in the First and Second Interim Reports, which later will be made more rigid. This would tend to discard some of the present findings which are included now on a tentative basis. Such tentative findings have been so noted. Later analyses with more rigid criteria will be used for final presentation of these findings.

FOREWORD

This is the second statistical report on a study of 501 Navy ASHD patients diagnosed for this disease in 1950 and 1951. The first report covered a general description of the sample and of the procedure followed in the data collection and analysis. (See Table 1 for basic sample description).

This first report set forth a major premise--that the character of the first episode predetermined to a large extent the nature of the patient's future. This premise was born out by the preliminary findings as were corollary premises--(1) that the number of episodes was also a heavily determining factor in the patient's future, and (2) that age was also important.

Other variables we think probably related statistically to development of ASHD (or to triggering its onset or to progression to later stages) are discussed in this report, with the contributive evidence in the form of mortality rates, survival-time data and case fatality rates.

Data comparing these heart patients with a correspondingly age-matched group of healthy controls are also presented in this second report together with a few comparisons with cross-sections of the whole Navy membership.

Most of the foregoing evidence will be supplied later as input to a multiple regression program in an IBM 1620 computation to establish relative order of importance, the relative magnitude of total explained survival-time effect, and the size of the unexplained part of this effect. These results will be included in a later report.

This ASHD Study was initiated in 1963 under the sponsorship and general guidance of Dr. Paul R. Engle, Captain, USN and at that time Director of The Division of Physical Qualifications and Medical Records. The study was conducted by Mr. John R. West, statistician, who made the analyses, with the medical advice of a panel of five physicians attached to this Division and of Dr. J. G. Esswein, Captain, USN, the present Division Director. The panel of doctors included Navy Medical Corps commanders Mary T. Lynch, F. O. O'Connell, J. W. Flynn, H. O. Kretzschmar and LCDR C. J. McGrew Jr., MC., USN.

TABLE 1: OFFICIAL COUNTS FOR ASHD STUDY SAMPLE
(In Numbers of Patients)
(As of 1 January 1963)

Rank/Rate Status	TOTAL	ASHD PATIENTS	NON-ASHD PATIENTS
(a) TOTAL	552[a]	501	51
Officers	227	210	17
Enlisted	325	291	34
(b) LIVING (TOTAL)	267	241	26
Officers	118	108	10
Enlisted	149	133	16
(c) DECEASED (TOTAL)	285	260	25
Officers	109	102	7
Enlisted	176	158	18

[a]Excludes 3 regular Navy officers, now deceased, for whom the number of episodes and date of onset of the first several episodes are not known--due to incomplete medical records available for them. They were known to have ASHD, however, but the survival time and date of onset can not be estimated.

I: INTRODUCTION

1. Résume of Previous Findings

A number of factors were earmarked in the First Interim Report on the basis of preliminary data, as probably relating to development or to progression of ASHD--on the basis of differences in the proportion of each of these factors among living and among deceased ASHD patients. Such factors were: (1) age at onset, (2) a prior history of hypertensive or borderline blood pressure, (3) a prior history of obesity, (4) the character (severity) of the first episode, (5) its cardiac complications, and (6) the number of subsequent episodes.

In addition, on the basis of a substantial portion of the heart sample displaying certain other qualities (both among living and dead), the following additional factors were earmarked as possibly important: (7) recall from reserve ranks to active military service for the Korean affair (this factor applying principally to enlisted men), (8) rank of officers,[1] (9) prior cardiovascular history of the patient himself*, (10) family history of cardiovascular disease and/or diabetes, (11) poor condition of teeth*, (12) minor ill-health*, and (13) VD history*. Moreover, a (14) very high proportion of heart patients had positive ECG's on the first or on subsequent episodes (85 percent).

Further progression of serious complication following the first episode--particularly cardiac complication--might be indicative as a measure of ASHD progression (15). Data on "battle stress" possibly may

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[1] We now think however, this factor probably to be merely the result of their increasing ages with increase in rank.

*Prior to ASHD onset.

also be useful for correlation with development of ASHD, but we do not yet know how to evaluate such information (16).

2. Plan for Further Analysis of these Present Data

All the factors discussed above in Section 1 are to be used as input to a 1620 program for Multiple Regression Analysis Procedure (MRAP). This computation selectively adds data for one factor at a time, tests this addition for statistical significance, and measures the statistical contribution of each accepted factor to the combined total.

This combined total is the "explained" portion of the ASHD progression effect--represented in the computation by the calculated multiple regression coefficient. This effect is, of course, an inverse function of survival time. The complement of this coefficient, therefore, is the unexplained portion of the development effect--for which research people need to look elsewhere for suitable explanatory data.

3. Areas of Data Not Provided For

Because of lack of adequate data sources, in this investigation we have not considered a number of items of data which many ASHD investigators think may be important. These are: (1) alcohol consumption, (2) smoking extent, (3) diet, (4) extent of stresses of the following kinds: emotional, financial, situational, and job, and (5) adjustments to tasks, activity and associates. These data should be collected by research investigators and should be added to a MRAP computation, to the array which we have considered here. Such an attempt might go further in explaining the progression of ASHD.

II: SUMMARY OF MAJOR FINDINGS DISCUSSED IN THIS REPORT

1. First Episode Character

The character (severity) of the first ASHD episode appears to have a very strongly determining influence on the probable remaining future life of an ASHD patient. This is demonstrated both by mortality rates and by relative survival-time (see p. 11, and Tables A, B, in Appendix A). The more severe the first episode, the less chance there is of long survival.

2. Number of Episodes

Likewise, the total number of hospitalized major coronary episodes experienced by the patient also are earmarks to his future--survival time declining with an increase in the number of episodes (Tables C and D).

3. Age at Onset

Among deceased patients only, survival time is an "inverse" function of age at onset--that is, the older patients live longer. In contrast, sudden deaths have the lowest age-at-onset (p. 13; Table F).

4. Ponderal Index

Above age 25, the relative weight of ASHD patients ("ponderal index")[2] is consistently higher than for normal controls--ranging from 11 percent excess at age 30 to 19 percent at age 45--with 17 percent excess

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[2] Actual weight/height ratio divided by a desirable weight/height ratio (that of the Metropolitan Life Insurance Company). This exploratory use of the term "ponderal index" is inverse to the usage by C. C. Seltzer and associates at Harvard and is not intended as a substitute for the latter. It is convenient, however, for direct comparison of weights of patients and controls.

at the first episode (Table 4). Among controls, overweight, although less marked, also exists.

5. Hypertensive Blood Pressure

ASHD patients with hypertensive or borderline blood pressure constitute a higher proportion among the deceased than among the ASHD living and a higher proportion among the latter than among controls (pp. 18-21). Moreover, patients of hypertensive blood pressure levels have shorter survival-time (Tables 5 and 6).

6. Cardiac Complications of First Episode

Presence of cardiac complications at the first episode lowers the chance for survival. Those patients with congestive failure had the shortest survival time and those with no complications the longest (Table 7).

7. Minor Ill-Health and Poor Teeth

Control patients had less minor ill-health than ASHD patients and had better condition of teeth, prior to the first episode, than did heart patients (Table 8 and 9).

8. Patient's Own Cardiovascular History and Family CV History

A substantial proportion of ASHD patients had a variety of cardiovascular difficulties prior to their first ASHD episodes. Control patients had many fewer of these in their entire medical histories. This difference between ASHD and control patients was also true of the family CV history but to a less marked extent (Tables 10 and 11).

9. Morbidity

Relative ASHD morbidity (ASHD diagnoses per 100,000 population-at-risk) increased regularly with age-at-onset of the patients. Enlisted

men had consistently somewhat higher rates than officers of the same age group. An exception were the patients under 30 years old for whom officer rates were slightly higher.

10. Other Minor Findings

ASHD patients had more incidence of prior VD infections than controls patients, more change in rank status and a higher proportion of reserve members recalled for the Korean crisis. However, we suspect all three of these effects to be fortuitous--perhaps related to the time periods in which these patients served in the Navy rather than to ASHD itself.

III: MATERIALS AND METHODS

Preliminary Analysis Procedure

Data presented in the First Interim Report were in gross analysis terms. That is, (a) comparisons were presented between the proportion of living patients having a specific characteristic (for example, high blood pressure) and the proportion of deceased patients with such a characteristic. Moreover, this analysis sometimes showed (b) a substantial fraction of the whole sample having such a characteristic although no noteworthy living/dead differences were discernible. Both of these two criteria (a and b) were used to earmarked possible relationships[3]. By this means 16 segments of data were selected for a more detailed and complex analysis discussed below. These 16 items are listed in Section 1 of Chapter I[4].

Additional Analysis Procedure Included in This Report

Following the crude selection of the foregoing 16 factors, additional analysis procedures were carried out in an effort to refine our previous findings and to screen this list to a shorter one. These additional steps described below are presented together with the findings, in Chapter IV.

(a) Survival-Time Groupings. This consisted of cross-tabulating the results of a particular data factor versus four major survival-time groups--i.e., (i) "sudden deaths", (ii) patients dying in less than 5

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[3] The use of the terms "relationship", "contributing" and "contributors" in this report is restricted solely to the statistical sense of these words; no "casual" implication is intended.

[4] Some of these 16 factors can only be considered as indicators of ASHD (such as positive ECG's)--not as contributors to its progression.

years, (iii) patients living 5 years or more but now dead, and (iv) patients now alive. By this means, as demonstrated in the First Interim Report, severity type of the first episode, total number of episodes and age-at-onset were determined to bear important relationships, probably, to development, onset or progression of ASHD. This same procedure was applied, in addition to the foregoing 16, to a substantial number of other available data items. Most of these latter showed no suggestive relationship to survival-time and have therefore been dropped from our active list. However, for a few there was other strongly suggestive evidence resulting from other procedures, which weighed in favor of their retention.

(b) Comparisons of ASHD Patients with Healthy Controls. Certain types of data--such as family history, patient history, weight/height ratio, blood pressure, condition of teeth, etc.--were available for a group of presumably healthy controls. These controls were an age-matched group of Navy members representing a cross-section of the active Navy roster of officers and of enlisted men toward the end of 1962. A very few of this group have subsequently been rejected as controls because they have developed ASHD or a related disease since then.

Those retained are regarded as suitable controls although they do not represent the same cohort years as our heart sample, since they were taken from a Navy cross-section drawn 10-11 years more recently than the onset dates of the ASHD patients. This later selection resulted in one anomalous contrast with heart patients. Active "war" and "battle stress" experience of some of them was necessarily different--due obviously to the course of events. There was no opportunity for many

of the youngest to have had World War II or even Korean battle experience. We think other comparisons of this control group with our heart patients are valid, however.

(c) Fatality Rate Analysis. "Case fatality rate" is a computation, by survival-time groups, of the number of patients dying by the end of a particular survival-time period divided by the number of live persons entering that period. This methodology is used in annual steps by most life insurance companies in presenting such rates, which they label "mortality rates", on large numbers of policy-holders, by age, sex, and various classes of risks.

Because of the relatively small number of patients in our sample, however, it was necessary to use longer survival-time groupings, as set forth in Section II (a) above, rather than by annual periods used for life insurance purposes. This procedure, presented in a form familiar to many physicians, confirmed results of our other analyses. However, like the survival-time groupings, this computation necessarily lumps all live patients in one survival-time group--with no distinction between live patients suffering one or more severe episodes and those not so affected. This deficiency we think is being overcome by subsequent procedures.

Next Steps Required in Analytical Procedures

(a) Severity Index Analysis. A further procedure was devised as a screening technique which we hope will enable us to use data for all live patients as well as for the deceased in later regression analysis. This step, the use of a severity index, is a system of assigning arbitrary but reasonable weights to selected factors relating to each

patient. These selected factors were those which previously were shown probably to be strongly related to ASHD progression. The first six to be tested will be: (1) 1st episode type (mild or severe); (2) 1st episode cardiac complications (congestive failure, prior infarction, etc.); (3) number and severity of subsequent episodes; (4) age at onset; (5) obesity (maximum ponderal index); and (6) blood pressure at first episode. Subsequent testing will add additional factors and vary the weights on a trial-and-error basis. Results of these computations are to be reported later.

This index number, because of the method of construction, should bear an inverse relationship to survival-time for dead patients. A cross-classification of "severity index vs survival-time" for such patients should bear this out. If so, we should, therefore, be able to use the severity index as a dependent variable for regression analysis for living patients as well as for the deceased (instead of survival-time).

(b) Multiple Regression Analysis Procedure (MRAP). This procedure will be applied to all the possible ASHD factors, screened to no more than 20 items by means of the foregoing methods. This screening will have removed most of the items which appear to contribute little or nothing to ASHD progression as well as those for which the data are believed to be the least reliable.

The resulting analysis should weigh each screened factor, determine its relative statistical contribution quantitatively, apply an acceptance test for statistical significance, and compute the resulting sum of all the individual contributions. This sum mathematically is the

square of the multiple correlation coefficient, (the R^2). These results should allow one to write an equation describing this multiple relationship--the "R^2" measuring the extent of the explained portion of the ASHD survival-time effect. The R^2 complement ($1-R^2$) would measure the remaining fraction, unexplained by the data factors used in this computation. The relative size of this unexplained complement should indicate the extent of need for further data collection, factor analysis and other methods of investigation for an ultimate solution.

(c) Administrative Observation Periods. Questions related to the timing and character of administrative steps taken in observation, evaluation and final disposition of these patients, can be answered by an analysis of the character, distribution, average value, and range of these time periods. This analysis should take into account major factors involved in this disease and should, therefore, be based on results of the MRAP task.

This investigation should take into account the relationship between severity of the first episode attack and the speed of disease progression. The corresponding disposition status and basic disability allowance should be considered as well as subsequent changes in this status and allowance. A supplementary aspect should include an analysis of changes made by higher authority in disposition status and the correspondence with medical background for such changes.

(d) Final Review of Morbidity/Fatality Status. A review of the ASHD sample status, as of January 1966, should be made this spring, to bring the mortal ratio and fatality rate data up to date--in view of the few deaths since January 1963.

IV: RESULTS

BASIC FINDINGS ON ASHD RELATED FACTORS

Several topics in this report discuss ASHD related factors also covered in the First Interim Report. We have reiterated their importance here by discussions in somewhat different terms than previously--with more conclusive statistical evidence.

First Episode ASHD Type

The nature of the first ASHD episode appears to be a strong indicator of the future course of the disease in these patients. Those with "mild" first episodes (angina pectoris, acute coronary insufficiency, and atypical mild and asymptomatic ASHD types) have a mortality one-half as high as those with severe first episodes (myocardial infarction with or without congestive failure, left bundle block associated with congestive failure, and "fatal arrhythmia"). (See Appendix A, Table A).

The 72 sudden deaths in our sample have a large effect on the overall mortality for the severe cases, of course. However, even when the sudden deaths cases are excluded (see Table B), the mortality pattern for the mild and for the severe cases is still quite different.

The proportions of dead patients in each survival-time group, moreover, is smaller among mild first episode patients than among severe first episode cases.

Number of Episodes

Survival-time is an inverse function of number of episodes. Thus for persons with only one episode, 41 percent have died. For patients with 2 episodes, 61 percent have died--half during the first five years.

For patients with 3 or more episodes, 65 percent are now dead. (See Table C, Appendix A).

These data are presented in a slightly different fashion in Table D in Appendix A which shows the number alive on the beginning of the 5th year and the 10th year, and those still alive at the cut-off date, 1 January 1963.

Table 2 below shows these data in a still different form--emphasizing the effect of a severe first episode (vs. a mild first episode) in terms of gross mortality and "actual" vs "expected" mortality. This table also illustrates this effect in terms of an increasing number of episodes.

The inverse relationship of first episode type (severity) to survival-time, as discussed above, exists in a corresponding manner for first episode type to number of episodes, as shown in Table E in Appendix A. That is, the more severe first episodes are followed by more subsequent episodes and vice versa.

TABLE 2: MORTALITY BY NUMBER OF EPISODES

Number of Episodes	Case Fatality Rate[a]	Actual Vs. Expected Mortality Ratio[b]	1st Episode Type Severe vs. Mild Ratio[c]
	(Includes "sudden deaths")		
ALL PATIENTS (501)	0.519	1.00	1.15
With 1 Episode (251)	0.414	0.80	0.96
With 2 Episodes (169)	0.609	1.17	1.44
With 3 + Episodes (81)	0.654	1.26	1.80

[a] By end of cut-off date (1 January 1963), total mortality.
[b] "Expected Mortality" is that shown in the whole sample; actual vs expected is the ratio, for example, for those with only 1 episode, of 0.414/0.519, or 80 percent.
[c] This ratio is the ratio of number of severe 1st episodes divided by number of mild ones (for total, this is 1.15).

Age at First Episode

Table F in Appendix A shows the 5-year age distributions of ASHD patients for age at first episode, by survival-time groups. The following is evident: "sudden death" patients had onset at somewhat earlier ages--on the average--than any other survival-time group (40.0 years vs. 42.6 years for the next survival group). Patients surviving less than 5 years (even excluding sudden deaths) were considerably younger at onset than those deceased who lived 5 years or more.[5]

Relative Weight and Blood Pressure

The following discussion deals first with relative weights ("ponderal indices") of ASHD patients and secondly with relative blood pressure. A final section shows some statistics for the sizable group of heart patients who were both overweight and had hypertensive blood pressure levels.[6]

Ponderal Index at First Episode. "Ponderal Index" is the quotient of (1) a given patient's weight/height ratio, divided by (2) a standardized, "desirable" weight/height ratio for a person of the same height. For this discussion, the comparison with a standard was based on the

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[5] The latter group were older at first episode than any other--older even than were patients who are still living today (with a median of 45.5 years for "long-lived deceased" vs. 43.1 years for "still living"). Obviously, other factors as well as age-at-onset, were quite important for those who lived.

[6] The latter discussion is included because some cardiovascular experts contend that blood pressure normally increases with relative weight (and therefore should be discounted to some extent in labeling patients as hypertensive or not). Data in Table 5 would suggest that the combined effect is less than for either hypertension or obesity alone, but this will be determined later.

Metropolitan Life Insurance Company's "desirable weight" tables.[7] Survival-time analysis of such first episode Ponderal Index figures for 501 ASHD patients in this sample reveals generally what one would expect. Mortality rises (except for one small group of 35 patients) with increasing relative obesity (see Table 3).[8] Thus, while at ten years after onset, forty-two percent of the patients with "normal" Ponderal Indices at first episode had died, about forty-nine percent of those with "an obese" Ponderal Index were deceased. (See Table 3a.) Except for the 35 persons with "low" indices, "total mortality" for these ponderal index groups, shown in line 2 of Table 3, also reveals the same consistent trend.

Comparison of Ponderal Indices of Heart Patients and Controls

Table 4 shows a comparison of the change in relative weights of heart patients compared with those of controls (Navy members on active duty in October 1962). Heart patients at age 45 reached a maximum of 14 percent over their corresponding relative weights at age 25 and at the same age a maximum of 19 percent over the "desirable weight" standard of the Metropolitan Life Insurance Company. In contrast, the controls were only 11 percent over their age-25 Ponderal Index and only 15 percent

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[7] Metropolitan Life Insurance Company, Statistical Bulletin, No. 40 (Nov.-Dec. 1959). Two other indices were also calculated: (1) the actual ratio divided by the age-25 ratio; and (2) actual divided by Navy's middle standard. (See footnote 9, page 18.)

[8] An anomalous feature, however, appears in the survival-time data for the 35 patients with "low" Ponderal Indices at first episode (below the standard weight for their height). These patients show a much higher total mortality and less favorable survival-time distribution than patients with normal, intermediate, or even high Ponderal Indices. However, the size of this group is too small for much significance to be placed on these unusual findings, which will be explored further in a later report.

TABLE 3: PONDERAL INDEX AT FIRST EPISODE BY SURVIVAL-TIME
(Based on Metropolitan Life Insurance Co's "desirable weight tables")

SURVIVAL TIME	ALL ASHD PATIENTS		PONDERAL INDEX GROUP[a]							
			LOW		NORMAL		INTERMEDIATE		OBESE	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
TOTALS	501	100	35	100	115	100	134	100	217	100
DECEASED	260	52	22	63	53	46	66	49	119	55
Sudden Deaths	72	14	7	(*)[b]	14	12	22	16	29	13
Survived less than 5 years	93	19	6	(*)[b]	22	19	20	15	45	21
Survived 5 years or more but now dead	95	19	9	(*)[b]	17	15	24	18	45	21
LIVING	241	48	13	37	62	54	68	51	98	45

[a]"Low" includes indices below 1.00; "normal", indices of 1.00-1.09; "intermediate", indices of 1.10-1.19; and "obese", indices of 1.20 or more.

[b]Percentages are not reliable because the statistical base of 35 is too small for use for this purpose.

TABLE 3A: FIVE AND TEN YEAR MORTALITY RATES BY PONDERAL INDEX GROUPINGS
(At First Episode: Based on Metropolitan Life Insurance Co's "desirable weight tables")

Ponderal Index Group[a]	Total ASHD Patients		DEAD ASHD PATIENTS					
			Five Year Mortality Rate[b]		Ten Year Mortality Rate[c]		Total Mortality Rate[d]	
	Number	Percent	Number	Rate	Number	Rate	Number	Rate
TOTALS	501	100	165	0.329	233	0.465	260	0.518
LOW	35	7	13	0.371	17	0.486	22	0.629
NORMAL	115	23	36	0.313	48	0.417	53	0.460
INTERMEDIATE	134	27	42	0.313	61	0.455	66	0.495
OBESE	217	43	74	0.341	107	0.493	119	0.548

[a]Low includes indices below 1.00 normal, indices of 1.00-1.09; intermediate, indices of 1.10-1.19; and obese, indices of 1.20 or more.
[b]Five-year mortality equals the sum of the sudden deaths plus all others living less than 5 years.
[c]Ten-years mortality rate includes all of the sudden deaths plus all others living less than ten years.
[d]Total mortality rate includes sudden deaths, all those surviving less than ten years, and those dying between ten years and the cutoff date, 1 Jan. 1963.

TABLE 4: PONDERAL INDEX OF HEART PATIENTS VS. CONTROLS[a]
(Median Values Based on 10 Class Index Grouping)

Date or Age	ASHD PATIENTS			CONTROL PATIENTS		
	Number of Cases	Ponderal Index		Number of Cases	Ponderal Index	
		Per Age 25	Per MLI[b]		Per Age 25	Per MLI[b]
Navy Entrance	501	1.00	1.00	619	0.97	0.98
25 years[c]	501[d]	1.00	1.05	619	1.00	1.05
30 years	378	1.06	1.10	468	1.05	1.08
35 years	372	1.10	1.14	435	1.07	1.12
40 years	349	1.13	1.17	365	1.09	1.13
45 years	287	1.14	1.19	236	1.11	1.15
50 years	172	1.14	1.18	127	1.12	1.17
55 years	102	1.14	1.16	88	1.11	1.14
1st Episode	501	1.12	1.16	-	-	-
Last Episode or at Death	501	1.11	1.16	-	-	-

[a]Heart patients in this table exclude 51 cases adjudged to be in a non-ASHD status. This exclusion has resulted in no substantial change, however, in the ponderal index series.

[b]Metropolitan Life Insurance Company's "desirable weight" standard used as a base of comparison.

[c]Not all of these 501 patients had an age-25 weight/height reading because some of them entered the Navy at a higher age--notably during WWII. For these patients, we have substituted the next nearest 5 year age level values or entrance date values--which ever were closest.

[d]The decline in number of patients represented at each age-level above 30 years is due to two-factors: (i) the fewer number of total patients at each age and (ii) the deaths of some of them at the higher age levels.

over the Metropolitan standard at the same age 45. These differences are based on all heart patients alive for whom weight readings were available at each age level. A cross-tabulation by survival time might suggest even larger differences, since the patients dying earlier may generally be presumed (Tables 3,3a,4) to have been heavier (and the comparison among these still living patients, therefore, understated). (See Table G in Appendix A).

The age-25 adjustment was intended to take into account automatically an allowance for the relative heaviness or lightness of the patient's bony and muscular structure, which would have been developed in most instances to a maximum by that age.

An adjustment to the middle range of the official Navy standard[9] followed closely that of the Metropolitan Life "desirable" series--the Navy allowing a slightly heavier optimum build at all age levels. This slight difference is not enough, however, to cover up the foregoing differences between heart patients and controls.

Prior Obesity and Hypertensive Blood Pressure[10]

Prior Obesity. An additional rough measure of the patient's relative obesity was obtained by comparison with the Navy's "middle range" standard. This comparison is shown for (1) control patients, (2) living ASHD patients and (3) deceased ASHD patients in Table 5(a).

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[9] Manual of the Medical Dept, Chapter 15, pp 15-17.
[10] Prior to first episode.

This table shows 44 percent of the controls as having "some"[11] or "much" obesity in October 1962. In contrast, 54 percent of living ASHD patients and 60 percent of the deceased were some or much obese prior to the first episode onset.

Prior Hypertension. A rough comparison of blood pressure levels prior to ASHD onset was made between the heart patients and the controls.[12] The latter showed 19 percent as having borderline or hypertensive blood pressure (135/85 mm Hg or higher) compared with 32 percent for living ASHD patients and with 37 percent for the deceased. (See Table 5b.)

Prior Hypertension and Obesity. A rough measure of the proportion of ASHD patients and controls having both hypertensive blood pressure levels and obesity is shown in Table 5c.[12] These proportions were 53 percent for controls, 63 percent for living ASHD patients and 71 percent for dead ASHD patients.

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[11] For this table, "some" obesity included patients with roughly more than 10 percent overweight for their heights, as measured by the Navy middle range allowance. "Much" obesity was somewhat less well defined and included those who were "grossly overweight", generally 20 percent or more.

[12] It must be remembered that some of these ASHD patients (including many of those who had substantial hypertensive blood pressure levels prior to onset of ASHD) were already receiving antihypertensive drugs prior to ASHD onset. These patients' real blood pressure levels (if not so medicated) were, therefore, understated. Moreover, nearly all of those who had substantial hypertensive levels at the time of the first episode (and later) were also receiving antihypertensive drugs; the recorded blood pressure was also understated for them in terms of real blood pressure without medication.

For these reasons, all the foregoing data shown in Tables 5b, 5c, and 6 are understatements of the relationship between blood pressure, survival-time and progression of ASHD.

TABLE 5: PRIOR BLOOD PRESSURE AND OBESITY: ASHD PATIENTS VS. CONTROLS

(a) Relative Prior Obesity

OBESITY SCALE	CONTROLS		LIVING ASHD		DEAD ASHD	
	Number	Percent	Number	Percent	Number	Percent
TOTAL	621	100	241	100	260	100
none	347	56	110	46	104	40
some	257	41	117	48	144	55
much	17	3	14	6	12	5
some or much	274	44	131	54	156	60

(b) Prior Blood Pressure

BLOOD PRESSURE SCALE	CONTROLS		LIVING ASHD		DEAD ASHD	
	Number	Percent	Number	Percent	Number	Percent
TOTAL	621	100	241	100	260	100
Normal	501	81	163	68	165	64
Borderline	104	16	41	17	60	23
High	16	3	37	15	35	13
Borderline or higher	120	19	78	32	95	36

(c) Prior Blood Pressure and Obesity Combined

COMBINED B.P. OBESITY SCALE	CONTROLS		LIVING ASHD		DEAD ASHD	
	Number	Percent	Number	Percent	Number	Percent
TOTAL	621	100	241	100	260	100
Grade 0	291	47	90	37	76	29
Grade 1[a]	317	51	117	49	156	60
Grade 2[b]	13	2	34	14	28	11
Grades 1 and 2[c]	330	53	151	63	184	71

[a] Grade 1 hypertension/obesity constitutes borderline blood pressure and some obesity.

[b] Grade 2 hypertension/obesity constitutes definite hypertension and much obesity.

[c] Grades 1 and 2 are those having borderline hypertension (or more) and some obesity (or more).

Grade 0 therefore constitutes the remainder--having neither hypertension (even borderline) nor any obesity.

TABLE 6: ASHD BLOOD PRESSURE GROUPS PRIOR TO ONSET
(By Survival-Time Groups)

SURVIVAL TIME GROUPS	ALL PATIENTS		PATIENTS WITH NORMAL LEVELS[b]		PATIENTS WITH BORDERLINE OR HIGHER	
	Number	Percent	Number	Percent	Number[c]	Percent
TOTAL	429[a]	100	278	100	151	100
Surviving less than 5 years	93	22	55	20	38	25
Surviving 5 years or more	95	22	60	21	35	23
Living	241	56	163	59	78	52

[a]Excludes 72 "sudden deaths" for whom the medical record was deficient or non-existent regarding blood pressure immediately prior to onset.
[b]"Normal" blood pressure: pressures up to 134/84 mm Hg.
[c]"Borderline" or higher: 135/85 mm or more.

Prior Blood Pressure by Survival-Time Groups

Analysis of ASHD patients' prior blood pressure history shows a consistent relation with survival-time, as shown in Table 6.[12] Among the patients who are still alive, more than two-thirds (163 + 241) had "normal" prior blood pressure readings (below 135/85 mm Hg). Among the deceased patients who survived for 5 years or more, this proportion is somewhat less than two-thirds, (63 percent). Among deceased patients surviving less than five years, the proportion with "normal" reading is even lower (59 percent). Seventy-two (72) sudden death cases were eliminated from the distribution in Table 6 because of the large proportion of patients in this group for whom prior blood pressure readings were unavailable or unreliably reported. Data including these 72 cases are shown in Appendix A, Table H.

[12]See footnote on page 20.

First Episode Cardiac Complications

Table 7 shows 429 ASHD patients classified according to survival-time groupings and presence of cardiac complications. Seventy-two (72) sudden death cases were excluded here also because, in most instances, information concerning such complication was incomplete or lacking altogether. The 429 patients have been grouped into three classes: (1) patients with no evidence of cardiac complications at the time of their first episode; (2) patients with congestive failure (with or without other complications); and (3) patients with all other types of cardiac complications.

Slightly more than a third of the patients with no cardiac complications subsequently died. In contrast, all of the patients with congestive failure, and nearly one-half of those with other complications, are now deceased. The differences in mortality are accompanied by a substantial relationship between absence of complications and length of survival.

Prior Minor Ill-Health and Poor Teeth (ASHD Patients vs Controls)

The medical records of many ASHD patients in this sample show frequent references to minor ill-health. These references include both occasional sickness of the foregoing type as well as more frequent occurrences. These minor illnesses include the following specific types: Frequent colds with mild fever[13], "flu", bacterial skin infections, and

[13] Occurring so frequently in some patients, that this type of illness was almost chronic for them.

chronic or frequently occurring indigestion or minor gastric disturbance. Occasional hospitalization for these reasons requiring more than a few days was not included however, in this category of minor ill-health. Table 8 shows these data in comparison with corresponding data for the group of active-duty controls.

TABLE 7: FIRST EPISODE CARDIAC COMPLICATION BY SURVIVAL GROUPS

SURVIVAL TIME GROUPS	ALL PATIENTS TOTAL		NO CARDIAC COMPLICATIONS		CONGESTIVE FAILURE[b]		OTHER CARDIAC COMPLICATIONS[a]	
	No.	Perct.	No.	Perct.	No.	Perct.	No.	Perct.
TOTALS	429[c]	100	246	100	19	100	164	100
Deceased Patients	188	44[d]	92	37[d]	19	100[d]	77	47[d]
Surviving: 5 years or less	93[c]	22	40	16	14	(*)[e]	39	24
5 years or more, now dead	95	22	52	21	5	(*)[e]	38	23
Living Patients	241	56	154	63	-	----	87	53

[a]Includes sinus tachycardiac, various arrhythmias, cardiac enlargement and digitalization. Does not include congestive failure.
[b]Includes cases with congestive failure alone and congestive failure plus something else.
[c]Excludes 72 "sudden death" cases for which cardiac complication status was incomplete or unknown.
[d]This percentage is equivalent to the "gross mortality rate".
[e]Percentages are not reliable because the statistical base of 19 is too small for use for this purpose.

TABLE 8: MINOR ILL-HEALTH OF ASHD PATIENTS VS. CONTROLS

HEALTH STATUS	ASHD PATIENTS		CONTROL MEMBERS	
	Number	Percent	Number	Percent
TOTAL	504	100	621	100
Little minor ill-health	242	48	550	89
A significant degree of minor ill-health	262	52	71	11

As with prior minor ill-health, the condition of ASHD patients' teeth was indicated by the medical records to be considerably poorer than for the controls. Most of this difference was due, however, to the presence of dentures. The prosthetics were in use in a very large proportion of the ASHD patient groups, some 39 percent of them having dentures (full or partial) as opposed to about 22 percent of the controls. (See Table 9 below).

Patients with dentures may be considered to have good tooth condition after their adoption. In most instances this substitute was supplied because the patient's teeth were in too poor condition to benefit substantially by repair. Moreover, even for those patients still having most of their own teeth, the ratio of ASHD members with poor tooth condition was substantially larger than for controls.

TABLE 9: PRIOR CONDITION OF TEETH (ASHD PATIENTS VS. CONTROLS)

PRIOR CONDITION OF TEETH	ASHD PATIENT		CONTROLS	
	Number	Percent	Number	Percent
TOTAL	504	100	621	100
Fair or good teeth condition	287	57	483	78
Poor condition or with dentures	217	43	138	22

Prior Cardiovascular History: ASHD Patients vs. Controls

Patient CV History. Prior cardiovascular history of the patient (not for ASHD) appears to be an important indicator to development of ASHD. Comparison of CV records of controls in our series and of ASHD patients prior to onset of the first ASHD episode also shows substantial differences in this regard (see Table 10). Medical records of 29 percent of our 501 ASHD patients show a prior CV history--compared with only 4 percent among the group of age-matched controls.

TABLE 10: PRIOR PATIENT CV HISTORY (ASHD PATIENTS VS. CONTROLS)

PRIOR PATIENT CV HISTORY	ASHD PATIENTS		CONTROLS	
	Number	Percent	Number	Percent
TOTAL	501	100	621	100
Prior CV History	146	29	28	4
No Prior CV History	355	71	593	96

Family CV History. A difference between ASHD patients and controls also existed for prior family history of cardiovascular disease, as shown in Table 11. However, for this comparison (family CV history), the difference is less marked than for the patient's own CV history. Thus 29 percent of ASHD patients had a family CV history whereas 20 percent of the controls had such a record.

TABLE 11: FAMILY CV HISTORY (ASHD PATIENTS VS. CONTROLS)

FAMILY CV HISTORY	ASHD PATIENTS		CONTROLS	
	Number	Percent	Number	Percent
TOTAL	501	100	621	100
Some Family CV History	146	29	125	20
No Family CV History	355	71	496	80

First Episode ECG Record

Positive ECG tracings were obtained at the first episode for 82 percent of all ASHD patients[14]--in 92 to 97 percent of those surviving the first episode but in only 13 percent of those dying suddenly. In those with positive tracings, a third showed only mild ASHD manifestations, the other two-thirds showing evidence of infarction. A very few tracings were borderline or fleeting but sufficient other evidence was available for these cases to confirm the diagnosis of ASHD. These data are shown in Table 12, and in more detail (with proportions showing evidence of infarction) in Table O in Appendix A.

Among patients dying suddenly, 78 percent had negative ECG's. In another 9 percent, an ECG was not obtained, as would be expected. However, that more than three-fourths of the ECG's obtained on these sudden deaths should be negative seems unusual. We are therefore investigating

[14]If detailed clinical records--together with accompanying ECG tracing were available in the Bureau's central office for each patient for whom a confirmed diagnosis of ASHD (or a variant of this) was made, this proportion obviously would be higher. Unfortunately, however, some clinical summaries of confirmed ASHD cases were not accompanied by the corresponding tracings or copies of them.

further the medical records of the 56 patients involved to see if there is any logical explanation.

For the 82 patients having negative ECG's (but other confirmatory evidence--usually clinical and/or autopsy), as previously noted, sudden deaths accounted for the large majority. However, there were 18 patients who are still living (7 percent of the living) and 8 more who have since died (4 percent of dead patients surviving the first episode) who had negative ECG tracings at the time of the first episode. The diagnosis for all these cases was based on other evidence.

TABLE 12: FIRST EPISODE ECG RECORD VS. SURVIVAL-TIME

First ASHD Episode ECG Results	All ASHD Patients	Deceased Sudden Deaths	Patients Living Less than 5 yrs.	Living 5 yrs/more	Still Living Patients
	(In Numbers of ASHD Patients)				
Totals	501	72	93	95	241
Positive ECG Tracing-Total	409	10	85	92	222
Negative Tracing	82	56	6	2	18
ECG not available[a]	10	6	2	1	1
	(In Percent of Each Column Total)				
Totals	100	100	100	100	100
Positive	82	13	92	97	92
Negative	16	78	6	2	7
Not Available	2	9	2	1	(*)

[a]ECG was not taken or if so, tracing is not referred to in Medical Record and it is not known whether one was made or not.
(*)Less than 0.5 percent.

The literature of ASHD studies includes a number of references to such cases--patients exhibiting positive symptoms and positive physical examination signs (and even in many cases, some positive laboratory and X-ray evidence) but with no positive ECG evidence or with ECG evidence only of an equivocal kind. Obviously for those patients in whom the disease had progressed through several episodes and who finally died, positive ECG evidence usually appeared at some stage substantially before death.

However, for the still living patients with mildest symptoms, first or later episode routine ECG's were not always helpful in confirming a diagnosis. If a Master Two-Step or other exercise test had been performed at an early stage for these patients, it is possible that positive confirmatory ECG evidence might have been obtained in nearly all of them.

In addition to the ECG evidence obtained at the first episode, from 5 percent (in the living) to 8 percent (deceased) of the whole ASHD group had positive ECG's prior to the first episode--many of them from Master Tests. We are investigating the type of first episode, the accompanying ECG and other evidence at that time and the survival-time of these patients in an endeavor to determine what weight this early-ECG information may have.

Prior VD Infection Record

A prior history of VD infections appears to be inversely related (statistically) to survival time in ASHD patients. Thus persons with no prior VD history were in the largest proportion among still living patients (67 percent). Among deceased patients, this "no-VD history"

group constituted 53 percent of sudden deaths, 59 percent of persons surviving less than 5 years, and 61 percent of those dead surviving 5 years or more. (See Table J in Appendix A).

The foregoing differences in ASHD survival-time groups cannot be ascribed directly to VD infection or freedom from it because there has been a significant change in methods of treatment of VD in recent years and probably in reporting this disease. Table 13 on the next page shows similar differences in the proportions of VD infection between enlisted ASHD patients, enlisted controls and officer ASHD patients--differences in line with the above survival-time differences. Here again radical changes in treatment and reporting may account for some of this effect.

However, it is possible that even larger survival-time differences might be apparent among the enlisted patients only--among whom prevalence of VD infection was considerably higher. We are, therefore, continuing to earmark prior VD infection as a statistical factor in the development of ASHD, to be explored further, particularly in relation to enlisted men.

ASHD Examination Signs (First Episode)

In contrast to the very high proportion of these ASHD patients who had specific ASHD symptoms (80-95 percent) and positive ASHD ECG signs (85 percent), there was a considerably smaller proportion whose central office medical records reported positive specific examination signs. These constituted 45 percent for living patients and slightly less then 40 percent for the deceased. An additional 20 percent in both living and dead groups had reports only of nonspecific signs (those not referring especially to ASHD). These, together with the specific signs, aggregate slightly more than 60 percent of both living and dead groups.

TABLE 13: PRIOR VD HISTORY: ASHD PATIENTS VS. CONTROLS

Prior VD History	ENLISTED ASHD PATIENTS		ENLISTED CONTROL PATIENTS		OFFICER ASHD PATIENTS	
	Number	Percent	Number	Percent	Number	Percent
TOTALS	291	100	391	100	210	100
No Prior VD history	162	56	267	68	151	72
Prior VD history	129	44	124	32	59	28

The remaining cases (36 percent living and 39 percent dead), had little or no specific or nonspecific examination sign evidence. These cases were either (i) patients dying suddenly, for whom a proper examination was not obtainable (10 percent), (ii) or patients for whom the clinical detail of examination signs was not reported to Washington, or (iii) patients for whom the diagnosis was based entirely on other evidence. This other evidence was in the form of ECG signs, lab tests, X-ray evidence, as well as the circumstantial findings in some cases of repeated later episodes with their accompanying information.

It is apparent that the objective evidence of the presence of ASHD on the first episode varied considerably. Positive ECG evidence apparently weighed the most heavily, followed in order of importance by general examination signs, than by detailed specific signs, then by X-ray, laboratory and other evidence. (See also Table K and L in Appendix A).

Table M in the Appendix shows a tabulation of the first episode specific signs[15] classified by survival-time groups. Survival time was

[15]Specific signs were: abnormal heart sounds, general and/or pulmonary edema; basal rales, venous distention or engorgement (particularly of neck veins), irregular or weak pulse, cough and orthopnea together, hypertemperature and rapid/shallow breathing.

shorter for patients with the more signs reported, most of this due to congestive failure and myocardial infarction signs.

It is also apparent that in many instances the central office clinical summary in the medical record of an episode of ASHD does not cite specific examination signs forming the basis for such a diagnosis. This basis is frequently summarized only by broad statements such as "suffered a myocardial infarction" or "developed congestive failure". Recourse to detailed hospital clinical reports probably would confirm such summary statements but these records are not readily available without much additional clerical work.

ASHD Patients Symptoms

In addition to examination sign evidence, there is also the more subjective evidence of symptoms reported by the patient. Sudden deaths excluded, no real difference is apparent between the living and the deceased in this respect. (See Table M and N).

Specific symptoms leading all others are anginal pain, pain radiating to shoulder(s) and arm)s), and dyspnea--with pain relief resulting from use of nitrates and/or narcotics being reported less frequently. A variety of other, less specific symptoms were also encountered but were reported much less frequently. Symptomatology, as reported in these central office summaries cannot always be considered as very strong evidence of ASHD. Nevertheless, when a decision was to be made to conduct a thorough physical examination and perform ECG and specific laboratory tests, the patient's symptoms usually pointed directly to ASHD.

Battle Stress

Battle stress as recorded in ASHD patients' medical records was defined as serious wounds or burns, extensive water exposure, prisoner-of-war experience, or lastly, an obvious record of activity under intensive battle conditions but without actual wounds or burns. Obviously the latter type of experience as well as extensive water exposure are under-reported in the medical record because such instances do not get recorded unless they become medical problems.

Nonetheless, our medical data show a direct relationship between survival-time and extent of battle stress. This is contrary to the effect of most of the other factors. Deceased patients dying suddenly included the smallest group reported with battle stress (22 percent) while those dead patients living the longest (5 years or more) showed the largest proportion with battle stress (35 percent). (See Table Q).

Corresponding data for patients still living are somewhat anomalous, 29 percent having had battle stress. As with Korean recalls, we believe this to be due to the inclusion of live patients with severe first episodes--probably a third of them--together with those who had suffered only mild episode(s). Consideration of such cases separately might produce more consistent results. This will be tested at a later time.

Apparent differences in battle stress between ASHD patients and controls are believed to be partly fortuitous--a result of the cohort years of members picked for this comparison. We may be unable to show a relation to ASHD progression as a result. A similar situation exists

with regard to changes in Military Status--between that of "officer" and "enlisted" and vice versa.

Continuity of Military Service

The question was raised as to whether recall from civilian status of reserve members has had any effect in triggering ASHD onset.

The data show a wide disparity between the proportion of officer patients who had been recalled (8 percent) from that of enlisted patients (34 percent). (See Table P in Appendix A.) A large difference would be expected in this regard expecially in view of the Navy's retention and recruiting policies following World War II and just prior to onset of the Korean activity. However, the survival-time grouping analysis, although showing some group differences in this respect, does not answer this question. A further analysis of this relationship among enlisted men only may be more informative. This will be reported later.

ASHD Morbidity Rates Among Naval Officers and Enlisted Men

Navy and Marine Corps strength rose very rapidly in the period January 1950--December 1951, the coverage months for drawing this ASHD sample. For this reason the roster strengths for the Population-at-risk (total Marine Corps and Navy Officers and corresponding total enlisted men) have been chosen for both years 1950-1951 combined, in computing ASHD morbidity rates. As thus computed, they are equivalent to annual rates, by five year age groups. (See Table 14.)

These rates have also been computed--by five year age groups--separately for officers and for enlisted men, because of the substantial difference in age distribution of the two groups. (See Table 14A.)

TABLE 14: PRELIMINARY ANNUAL ASHD MORBIDITY RATES PER 100,000 POPULATION-AT-RISK (Active Duty Navy and Marine Corps, Calender Years 1950-1951)

FIVE YEAR AGE GROUPS	TOTAL POPULATION AT RISK		ASHD PATIENTS[a]	
	Number	Percent	Number	Rate Per 100,000
TOTAL	1,309,839	100	501	38
Under 30	1,049,741	80	25	2
30 - 34	142,763	11	60	42
35 - 39	67,610	5	94	139
40 - 44	31,476	2	124	394
45 - 49	12,270	1	97	791
50 - 54	4,461	*	55	1,233
55 - Up	1,518	*	46	3,030

[a]Includes some persons whom we think had a first real onset of ASHD in 1949 or in earlier years; the fraction is estimated at about 18 percent of the 501 patient total. Most of the 18 percent had onset in late 1949 so that their first ASHD hospitalizations carried over and were counted in 1950. A proper allocation of these cases to morbidity figures for earlier years will require a detailed case-by-case study of their CV history (prior to the coded ASHD onset date).

Onset for most of the 18 percent mentioned above occurred in the years 1948-49 - not diagnosed until 1950-51. We feel that probably about the same number of men had an actual onset of ASHD in the years 1950-51 which were not diagnosed until 1952-53 so that the above figures approximate very closely to the true rate. Reallocation of the latter cases with true onset dates in 1950-51 but recorded onset dates in 1952-53 would require review of all 1952-53 diagnoses which we do not have easily available to us at this time.

*Less than 0.5 percent.

TABLE 14A: PRELIMINARY ANNUAL ASHD MORBIDITY RATES PER 100,000 POPULATION-AT-RISK (Active Duty Navy and Marine Corps, Calendar Years 1950-1951, Officers and Enlisted)

FIVE YEAR AGE GROUP	OFFICERS				ENLISTED			
	POPULATION AT RISK		ASHD PATIENTS[a]		POPULATION AT RISK		ASHD PATIENTS[a]	
	Number	Percent	Number	Rate[b]	Number	Percent	Patients	Rate[b]
TOTAL	137,736	100	210	152	1,172,103	100	291	25
Under 30	52,831	38	2	4	996,910	85	23	2
30 - 34	35,586	26	12	34	107,177	9	48	45
35 - 39	23,887	17	27	113	43,723	4	67	153
40 - 44	14,366	10	45	313	17,110	1	79	462
45 - 49	6,952	5	54	777	5,318	*	43	809
50 - 54	2,956	2	36	1,218	1,505	*	19	1,262
55 - Up	1,158	1	34	2,936	360	*	12	3,333

[a]See footnote (a) of Table 14.
[b]Annual morbidity rate per 100,000 population-at-risk.

The resulting preliminary figures are shown in Table 14 and indicate striking increases in the morbidity or incidence rates as age-at-onset rises, as would be expected from results of other ASHD studies. In addition, noteworthy differences occur between rates for officers and for enlisted men. The differences are chiefly in the age bracket "35-39" and "40-44" years. Smaller numerical differences also occur at ages "30-34", "50-54", and "55 and over" but the real significance for the latter three age groups is questionable at this time. (See note[a] to Table 14).

Case Fatality Rates[16]

The "case fatality rate" is computed as the number dying during a period divided by the number alive at the beginning of the period. Table 15 on the following page shows these fatality rates for various segments, by survival-time groups. These comparisons appear consistent with findings shown in earlier sections.

In general, officers show slightly lower fatality rates than do enlisted men--the exception being among those officer patients who lived 10 years or more (column 4 of Table 15), whose rate slightly exceeds that for enlisted men. Likewise, among most patients dying in less than 10 years, the patients who were younger at onset had higher fatality rates than older men. Persons having two or more episodes had higher fatality rates than those with only one episode.

[16]This "case fatality rate" method of computing "mortality rate" is frequently used by life insurance companies to express annual death rates for various age-classes and various classes of insurance risks. These rates are in contrasting terms to those expressed as the proportion occurring per 1,000 or 100,000 persons in the whole population-at-risk, which is a measure used by epidemiologists and others dealing in large civil population groups.

TABLE 15: CASE FATALITY RATES IN SELECTED SEGMENTS OF ASHD PATIENTS

SEGMENT OF ASHD PATIENTS	SEGMENT SIZE TOTAL[a]	AMONG SUDDEN DEATHS (IN LESS THAN 48 HOURS) (1)	AMONG THOSE SURVIVING LESS THAN 5 YEARS (2)	AMONG THOSE SURVIVING OVER 5 YEARS UNDER 10 YEARS (3)	AMONG THOSE SURVIVING 5 YEARS OR MORE (4)
(Case fatality rate = number dying in period divided by number alive at start of period)					
All Patients	(501)	0.144	0.217	0.202	0.101
Officers	(210)	0.114	0.199	0.188	0.107
Enlisted	(291)	0.165	0.230	0.214	0.095
By age at onset					
Under 35 years	(85)	0.271	0.258	0.196	0.135
35.0-44.9	(218)	0.151	0.211	0.178	0.033
45.0 and over	(198)	0.081	0.209	0.229	0.162
By number of episodes					
One Episode	(251)	0.287	0.123	0.032	0.033
Two Episodes	(169)	NA	0.314	0.353	0.120
Three or more	(81)	NA	0.222	0.349	0.317

[a]This number of patients constitutes the total for each line, of which a portion is represented by dead patients. The latter declines progressively in four groups by survival-time, as shown above. These sub-group totals are all over 100 cases, with the exception of the following: (i) patients under 35 years of age at onset are 85, 62, 46 and 37 cases, respectively, for columns 1, 2, 3, and 4; (ii) patients with 2 episodes surviving 10 years or more are 75 cases; (iii) patients with 3 or more episodes, for columns 2, 3, and 4, respectively are 81, 63, and 41 cases.

NA: not applicable since sudden deaths can experience only 1 episode.

Annual Case Fatality Rates Since 1950

No great change in the fatality rate among this group of ASHD patients had occurred since 1952 (the year following the last year any of them experienced a first episode). Table 16 below shows these data, reflecting only a very slight decline, as the more severely afflicted patients died--leaving as a remaining live group, those who were least afflicted. Eventually these rates should gradually approach those of normal life expectancy for the age groups of the remaining patients still alive.

TABLE 16: ANNUAL CASE FATALITY RATE[a] PER 100 LIVE ASHD PATIENTS (Calendar Years 1950-1963)

CALENDAR YEAR	FATALITY RATE[b] (PER 100 LIVE PATIENTS)	CALENDAR YEAR	FATALITY RATE[b] (PER 100 LIVE PATIENTS)
1950	10.6	1958	2.3
1951	13.4	1959	4.7
2 yr. mean value (1950-51)	12.0	1960	3.2
1952	4.6	1961	1.1
1953	3.0	1962	4.8
1954	3.3	1963	3.5
1955	4.6	5 year mean (1953-57) 5 year mean (1958-62)	4.0 3.2
1956	3.6		
1957	5.3		

[a] See definition in footnote 16 on page 34.

[b] With the exception of 1950 and 1951, these rates are only rough approximations and not intended as exact measures of relative mortality of these patients. This so because the sample size of patients dying in each of the years 1952-1963 is each too small to allow any great reliability to be attached to the resulting rates.

Survival Rate (for patients surviving 10 years or more)

The survival age, a figure complementary to a fatality rate, is defined in Table 17. These data (applying only to the half of the whole sample of 501 patients living at least 10 years) show a slightly higher rate for enlisted personnel surviving 10 years or more than officers living this long. This would appear to be related to the corresponding higher survival rate for patients under 45 years old at onset. As would be expected, survival rate also declines rapidly as the number of episodes increases.

TABLE 17: FINAL SURVIVAL RATES IN SELECTED ASHD PATIENT GROUPS SURVIVING 10 YEARS OR MORE
(Among 241 Still-Living Patients)

SURVIVAL GROUP	Number of Patients in Original Sample	SURVIVAL RATE[a]
TOTAL OFFICERS AND ENLISTED	(501)	0.899
BY RANK		
Officers Only	(210)	0.893
Enlisted Only	(291)	0.905
BY AGE-AT-ONSET		
Under 35	(85)	0.865
35-44	(218)	0.967
45-Up	(198)	0.838
BY NO. OF EPISODES		
One Episode	(251)	0.967
Two Episodes	(169)	0.880
Three or More Episodes	(81)	0.683

[a]Survival rate is the complement of the fatality rate and is computed by dividing the number still alive at the end of a given period by those alive at the beginning of this period. For these particular patients this period is from 10 or more to 15 years, depending upon onset date.

Morbidity and Mortality Rates in Members 30 Years Old or More
(Per 100,000 Population-at-Risk)

The enlisted Navy and Marine Corps are made up primarily of men under 30 years of age among whom there are relatively few cases of ASHD and even fewer deaths from ASHD--13 deaths out of the 23 enlisted patients who acquired this disease in 1950/51 under that age. There were only two ASHD diagnoses in officers under 30 in 1950/51--both of these men being still alive after 12 years. In order to remove the effect of the bulk of enlisted men (those under 30), and since young officers are more thoroughly screened than enlisted recruits, Table 18 is presented.

Morbidity Rate. For younger officers (30-44 years old), morbidity from ASHD is about the same as among enlisted men in this younger age range, as shown in column 3 of Table 18. (The difference is not statistically significant). Among older officers (45 and over), however, the officer morbidity rate is considerably higher than for enlisted men in the same higher range--1120 per 100,000 compared with 1030 per 100,000.

Mortality Rate. In contrast to morbidity rates, mortality rates for older officers (45 and over) are almost the same as for older enlisted men (see column 6, Table 18). However, among younger officers, the mortality rate is considerably lower--52.8 deaths per 100,000 compared with 61.9 deaths among younger enlisted men of the same wide age-bracket.

TABLE 18: ASHD MORBIDITY AND MORTALITY AMONG NAVY AND MARINES, 30 YEARS OLD OR MORE
(Cummulative Mortality After Average-12-Year Follow Up)

AGE GROUP	1950-1951 ACTIVE DUTY USN&USMC (Population at Risk)	ASHD PATIENTS	MORBIDITY RATE (Cases Per 100,000)	ASHD DEATHS	GROSS MORTALITY[a] (Percent of ASHD Pts.)	TOTAL MORTALITY RATE[b] (Deaths Per 100,000)
TOTAL-30 YEARS AND OVER	260,098	476	183	247	52	95
Officers	84,905	208	225	102	49	120
Enlisted	175,193	268	153	145	54	83
TOTAL 30-44 YEARS	241,849	278	115	143	51	59
Officers	73,839	84	114	39	46	53
Enlisted	168,010	194	115	104	54	62
TOTAL-45 YEARS AND OVER	18,249	198	1085	104	53	570
Officers	11,066	124	1121	63	51	569
Enlisted	7,183	74	1030	41	55	571

[a]Gross Mortality is percent of ASHD patients who have died within the approximately 12 years of follow-up since onset. For the under-30 group (excluded from this table), this comparison is valid, since there were no deaths among the two (2) officers in this age-group, while 13 of 23 enlisted men in this age-group have died.

[b]In spite of the lower mortality rate for younger officers (53 per 100,000 compared with 62 per 100,000 for younger enlisted men, the corresponding mortality rate for all officers of 30 years or more is much higher than for correspondingly-aged enlisted men (120 per 100,000 compared to 83 per 100,000 for enlisted men of those ages). This anomaly is due to the wide disparity between (1) the officer/enlisted roster strength ratios in these age brackets (total, 30-44, and 45 plus) and (2) the corresponding relative death ratios in these three brackets.